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ABSTRACT

Laptops for students, increased teamwork and group interaction, and teaching as a facilitator of active learning have successfully converged in the classrooms of Northern Michigan University. This paper offers practical guidelines for integration strategies, theory, and outcomes assessments, based on a study undertaken for the 1999-2000 academic year that involved 7 sections of 3 on-campus information systems courses (over 100 students and 2 professors). During the class, students sat at group tables with teammates facing each other. One or two laptops at each table were regularly used in team exercises. The instructor facilitated the work by moving around the room as a consultant. Some specific technology applied in the study included: presentation software; communication client software; electronic assignments; Internet as a resource for research and current materials; server space allocated to teams for teamwork; laptops; digitized pads for note-taking; a digital camera; and detailed course Web sites. Uses of each are described, followed by a discussion on the role of the team, the role of teaching, and study results. The study was still underway at the writing of this paper, but the general consensus is one of study preference for this approach, with some vocal dissidents. Two appendices include teaching and learning philosophies and a sample exercise in the interactive classroom style. (AEF)

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Technology, Teamwork, and Teaching Meet in the Classroom

By: Sandra Poindexter and S. Choton Basu

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Technology, Teamwork, and Teaching meet in the classroom

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Technology at Northern Michigan University has evolved to a student laptop requirement. Industry's expectation of teams and group interaction continues to increase. Teaching as a facilitator promotes active learning. With planning, these can successfully converge in the classroom. This paper offers practical guideposts for integration strategies, theory, and outcomes assessments.

Background

Interactive teaching paradigms, collaborative classrooms, and instructional technology as individual movements have existed for a decade, with some blending in recent years. A new factor, and the impetus for this study, is the adoption of laptop requirements. Beginning in Fall 2000, all full-time students and faculty at Northern Michigan University, a regional institution with approximately 8,000 students, will have a standardized set of technology tools (laptop, software, and Internet access). Network ports will be available in lounges, study rooms, labs, campus residence hall rooms, and faculty offices. Many classrooms already have a network port and others will be remodeled to accommodate electrical and network outlets at each seat.

Given that this is a mandatory program, accountability for the cost will be demanded by students, parents, and those who fund the university. For these initiatives to be perceived as valuable, faculty will be pressed into successfully integrating the laptop and network infrastructure into their course content and delivery. These are significant paradigm changes; faculty will need models and an idea of what can work and when to use various techniques. The point of this study was a reversal of a traditional lecture-based classroom (80% lecture / 20% interactive) to one of collaborative learning and interaction (20% lecture / 80% interactive). Various types of technology, including the laptop and Internet, were intensively integrated both in and out of the classroom to facilitate the learning process we are calling the 20/80 model.

Environment of the Study

To document approaches to these paradigm changes, a study was undertaken for the 1999-2000 academic year. Seven sections of three on-campus Information Systems (IS) courses, over 100 students, and two professors were involved with the yearlong project. During class, students always sat at group tables with two-four teammates facing each other. One or two laptops at each table were regularly used in team exercises. The instructor facilitated the work by moving around the room as a consultant. Teams were also urged to consult each other. The results of the exercises were e-mailed to the instructor during class, sometimes merged together at the instructor station and the solutions considered on the screen. The files are saved and posted to a web site as solutions for later downloading. The interactive exercises varied in software used and focus of material, but the laptop and technology were emphasized as resources as well as productivity tools. The interactive portion of the course consumed 80% of classtime, lectures only consisted of 20% of classtime.

Role of Technology

Too often technology is deployed without the building of purpose or consideration for appropriate use. Students quickly determine whether paper and pencil would be more appropriate for a particular task and claim technology is being used just for technology's sake. In this study, the goal was to shift the focus

from "finding ways of using technology in education," to asking "what learning outcomes do I want for this course" *followed by* "can technology help me reach those goals?" Some specific technology uses applied in the study included:

Presentation software. Some lectures were voice-annotated presentation slides that students viewed before class to summarize text materials. Other lectures were downloaded at the start of class and students followed along on their laptops.
Communication client software (e-mail, chat). To connect the students to instructor and students to students online routes were used. Rather than making students more isolated, out-of-class email appeared to open up an avenue for shy students and equalized their participation grade. Chat rooms were used by a few groups (primarily commuting students) as a sort of virtual team meeting place.
Electronic assignments. Most assignments were done in digital form and emailed to the instructor as attachments. The sending member copied all team members on the email. The assignments were usually graded in an electronic fashion by inserting comments directly into the document and returned via email. This method gave every person a copy of the team's submitted and graded document. This also freed up class time previously used for collecting and distributing papers.
Internet as a resource for research and current materials. In the study we did not assume students knew how to effectively conduct research on the Internet. An in-class exercise required students to select a topic, locate relevant and valid information sources, and consolidate it into a summary statement.
Server space allocated to teams for team work. Many documents written for the classes became too long to email as attachments, but document sharing continued using university-provided server drive space.
Laptops. For in-class interactive exercises for research, decision-support modeling, documenting, and querying shared laptops were the standard tool. Students downloaded the needed files from the class website or visited web sites to collect data, then worked on the exercises during class in teams. Whether there is one laptop per team or per student, having them available has made it easier to conduct some of the interaction exercises in class.
Digitized pads for note-taking. Students in the study found little use for these machines and preferred to take notes directly on their laptop or using paper. These tablets were a prime example of using technology without a firm educational goal; more thought should have been given to the course objectives of collaboration consensus before introducing the technology.
Digital camera. Photos (Fig. 1) were occasionally taken during class group time and posted in the class website. The purpose was to promote student ownership and involvement in the class, and to encourage students to frequently visit the website.

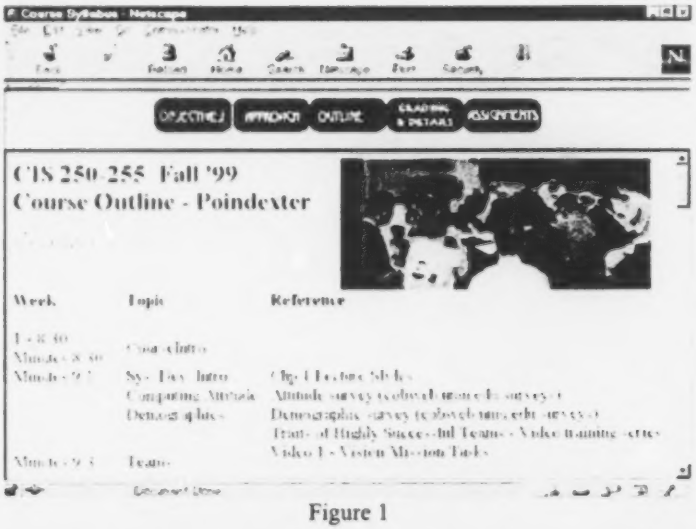

Figure 1

Detailed course websites. Providing a clearinghouse for all outgoing materials, historical archive, current activities list, and minutes taken by students on a rotating basis the website played a communications role. (Fig. 1)

A quick observation about this list is that these technology items are not particularly new or unique and often used by many instructors. The differential factor for the study is how extremely well integrated into the classroom they became—an integral part of the solution.

Having a technology-friendly classroom helped significantly. In order to utilize teams and technology, our minimum room configuration included an instructor computer with data projection and Internet connection, and movable desks to form workgroups. While interactive teaching can work in most classroom facilities, it may have significantly helped to redesign a room for this purpose. A grant was received to replace individual desks and long, narrow tables with sets of tables for teams of four. Seven laptops were purchased, one per table, with electrical outlets and network connections placed near each table. The intent was to enable software usage and Internet access during group exercises for research and instant file sharing.

By facing each other rather than the instructor, students were more active and more willing to risk an error with only a few peers listening; the instructor station was minimized as a focal point and source of knowledge. Tables also provided adequate workspace for groups to use laptops, spread out working material, and have a place for food that was often shared by the team. Some exercises required large sheets of paper to capture a team solution.

The Role of the Team

There are numerous examples in academia of the team approach. Traditional teaching tends to view teams as a group of people working together on a common objective, often merely grouping students to collaborate on a paper, project, or assignment outside of class, hoping for the best. A prominent complaint voiced during the initial meeting period regarded a lack of knowledge of team operations. One student captured the negative opinions by stating, "A lot of my instructors say they want me to work in teams to do projects because it's important, but no one ever teaches me how to work together in teams and it usually ends up being a frustrating and unproductive experience."

Teamwork in this study was defined to be a constant and conscious effort on the part of team members to work with peers as an effective and integral part of the learning, thereby forming "real" work teams. The instructor served more as a coach and facilitator than lecturer. A substantial amount of classtime was dedicated to the importance, functions, and dynamics of teamwork. It is important to note that 20% of the final grade depended on this type of classroom participation activity and their progress in reaching goals. Some of the main items covered were: establishing team vision/mission/strategies/rules, conducting effective meetings including group decision making tools, handling conflict, and understanding different personality types and learning styles.

Teams were created based on Myers-Briggs[1] temperament sorting, Kolb[2] learning styles, a generally available meeting time (morning, afternoon, or evening), and GPA. Some may disagree with this psychological grouping, but the study found slightly fewer team problems than previously experienced. One explanation is that temperament types permitted well-rounded teams instead of a random selections of all introverted, all procrastinators, or all leaders. Once established, the teams identified the strengths and weaknesses of their members. The groups discussed these results within the group and itemized ways they intended to help each other overcome their weaknesses. Team members were also asked to take inventory of their technical knowledge, then agreed to cross-train each other throughout the semester. As a secondary outcome of the classes, more students showed more improvement in their self-confidence and technical skills due to peer learning.

It also was observed that teams thrive when we established competition between teams and rewarded them with recognition or prizes, e.g. miniature candy bars. Several classroom exercises required teams to exchange ideas, collaborating and consolidating on a joint solution. This expanded the peer-to-peer network. Students were encouraged to bring food to class to remove the intimidating "sit quietly" mentality and leads to a more casual atmosphere, fostering dialog.

A series of videos on teams were used to help the students create their own team operating rules. It included discussion on goal setting and conflict resolution, historically the major problems in student teams. Examples of negative reinforcers created by student teams were denying assignment credit to a group member who had missed class without a valid excuse and requiring an unprepared group member to apologize before the class. Positive reinforcements include buying a soft drink for a team member whose job was well done or a sense of pride gained from sharing a skill with a teammate. These types of behaviors allowed teams to flourish and not be reduced to frustration when other members were not participating actively. Initial feedback and observation show that some teams were more bonded and performing at a higher level compared to teams in traditional instruction classes.

The Role of Teaching

In an interactive learning environment, course content objectives still had to be met, but lecture took a backseat to team exercises and experimentation as the primary course delivery. Outside of class, students were expected to read, outline, or review textbook and reading materials. Only the most complex items or items questioned by students were covered with an actual lecture. Class time was now free to do graded group assignments, case studies, and projects where diverse solutions were generated and shared. This led to some excellent critical thinking and problem solving. An attempt was made to utilize some interactive exercise in every class period.

The first few meeting periods of the studied classes were spent familiarizing students with the underlying philosophy of this teaching and learning approach (Appendix A). This was achieved via discussion, a small lecture component, an instructor philosophy statement, and an interactive exercise. This exercise (Appendix B) asked the students to define an interactive classroom based on their perception and compare it with other classes, followed by a questioning of the merits of this teaching approach over traditional teaching models, and addressing anxieties that might exist. During this session the instructors identified the goals, rules, and direction of the course. In some way, this allowed most of the students to align their mental models to the one presented by the instructor and alleviated some doubts and anxieties. In earlier unsuccessful experiments with the interactive team approach, an invalid assumption was made that students would automatically understand and shift to the participative learning style. This error was corrected in the current study.

Three examples of interactive class time exercises will be described here to illustrate this approach. In these exercises, the instructor's role is to move through the room consulting with teams, providing suggestions, and occasionally bringing the class together for common issues.

Consensus decisions. A decision needs to be made as to the best alternative for an IS project. Pros and cons are discussed in the class, then among the teams. Each team downloads to their laptop a ranking spreadsheet prepared with weighting and tallying formulas, enters in their choices, and views the resulting tallies. These files are emailed to the instructor and merged at the instructor station into a consolidated tally and all teams given a chance to explain their ratings. Teams may then change their ratings, repeating the cycle until there is consensus.

Summarizing and presenting. Students are assigned websites to read and questions to consider prior to class. In class, teams consolidate their answers into one document that is sent to me. Teams are then assigned one question and given 20 minutes to prepare PowerPoint slides that will depict their answer. These slides are merged at the instructor station and a spokesperson from each team comes up to explain the team answer.

Research. A current IS topic is brainstormed in class by the unit as a whole. A list is typed at the instructor station based on student identification of issues to investigate on the topic. Teams of students download the list immediately and begin in-class research on the Internet to locate the needed information and determine its validity.

Whatever the exercise, there is an absolute expectation that outside readings and text materials have been read prior to class. Sometimes testing for new knowledge was conducted by checking for terminology at the outset of some class period. Post knowledge was assessed by asking students to write

down one thing they learned from that class period or asking teams to develop summaries of materials into presentation slides during the class period. Students are graded on their team's output for the class and their interaction in completing it, as well as on their individual participation. Students very quickly recognized they must come prepared because the class begins with some type of assessment of their knowledge and preparation. It should be noted at this juncture that lecture slides for the class are made available (including voice overlays prior to the class via the course website). The issue of a classroom full of passive, unprepared students did not often exist after a few meeting periods.

Results

Based upon the initial interactive exercise that defined an interactive classroom, anxiety was evident at outset. This is a new learning paradigm that takes some student adjustment. As one student worriedly stated, "you've taken away everything I know about studying and I'm not sure how to react." In part, student evaluations reflected some confusion as to purpose and exactly what was expected on projects.

To quantify the first semester's results, a 27-question exit survey was given in the fall semester to 80 students with key points shown in Table 1. There was very little deviation in the survey scores. Students felt positively about the experience.

Table 1. Exit Survey Results

Question / Issue	Mean (5 high)
Overall rating of interactivity	4.15
Using laptops in class to obtain materials, do exercises, and immediately post work is an effective use of the laptop technology that should be promoted in other NMU classes.	4.15
Class minutes, taken by class members, is a good way to summarize a class period's activities and provide reference and clarification for later review.	4.28
A test *should* be given for *each* one or two chapters, even though it reduces the class available time for discussion, exercises, and lecture.	2.88
A dynamic (changing) course outline web page encourages students to more frequently reference the outline than a printed outline distributed on the first day of class.	4.09
Submitting assignments as email attachments is better than handing in paper copies at class	4.20
Receiving electronically graded (comments in a different color font) assignments via email is a good way to get and store graded materials	4.08
Assuming the reading material is clear and complete, college students can learn most (60-80%) of course *content* knowledge (terms, skills, steps, etc.) by diligently studying the text and assigned outside readings.	2.83

In summary of that data, on a scale of 1-5 with 5 high, an average response of 4.15 was given for questions relating to interactivity. When asked to state a percentage breakdown for the class grade between individual work and teamwork, the response was 35% individual and 65% team. This was in contrast with voiced objections to the initial 40% / 60% breakdown stated on the syllabus. Students felt at the outset that 60% allocation was too high for the team grade, but later wanted more point allocation to teamwork. Students became accustomed to the integrated technology and rated several features quite high, such as 4.28 for the posting of student-taken class minutes.

It might be presumed that all students enter the course with high levels of computing competencies and willingness to use technology in all ways. This is not the case and peers helped each other learn new skills and overcome computer anxieties. The laptop became a centerpiece for the class periods, partially due to instructor emphasis on exercises that effectively made use of them. In one section, at the outset of the semester two students brought in their own laptops. By the end of the semester, 12 other students had purchased their own laptops and brought them to class after seeing their benefits.

Two striking measurable outcomes, scores on tests and final grades, were detected. One instructor was able to compare scores against two prior years of student data. Though not controlled for student sample differences, means for both test scores and final grades had slightly increased and standard deviation had decreased. Since assessment questions had not been made easier, one plausible conclusion is that peer learning was removing the gap between the high and low scores, and pulling everyone up slightly. Students seemed to agree this was likely as they had relied on their peers for help in studying for tests and felt comfortable asking their peers for clarification on text material during class time.

Three written comments are provided here to illustrate the general positive feedback. "I can't believe how much I learned in this course. I went from having very little knowledge of what a systems analyst does to developing a pretty good understanding of the whole process." From the standpoint of increased learning, attendance, and participation: "I paid attention and learned much more from the interactive lecture than if we had had a more traditional one." And on retention: "Combining hands-on with text is the best way to retain knowledge and not say [next semester] 'what did I learn [from last semester]'."

Once the pattern and pace were set for them, student expectations of the instructor also elevated above those of peer instructors, sometimes to an unrealistic level. It is important for the instructor to accept and deal with potential personal issues that arise from this type of teaching approach. No longer the star performer protected by an invisible barrier at the front of the room, the instructor becomes vulnerable. Once students were encouraged to be active, thinking members of the environment, they began to challenge and question the instructor and the tasks at hand. Questions were continuously asked of the instructor and each other, resulting in a classroom where students were prepared for discussion and it was safe to voice an opinion. "Make work" exercises were quickly rejected, therefore all assignments began with a learning objective that had relevance and was clearly explained and defendable. The "because I say so" or "I know best" attitudes had to give way to "let's explore together" and a respect for their need to understand motives. Reaching this level of critical-thinking was both rewarding and threatening. If students were expected to come to class well prepared, the instructor was given no tolerance to fail in this area either.

Conclusions

The study is still underway at this writing, but the general consensus is one of student preference for this approach with some vocal dissidents. However, a great deal of effort was put into shifting students into a new learning mindset. Lessons learned from earlier experiments proved that time spent explaining and retraining were needed. The belief that a computer literate generation will automatically adopt and thrive in a technology-rich educational environment is, we believe, proven a myth. In addition to grade records and student evaluation comments, data was collected using three different instruments: demographic, pre-attitude, and an exit survey. We found the approach works better in some settings than others—three sections of the same course varied in class meeting time as a comparison. The more often a class meets, the more successful was the adoption of technology, teamwork, and interactive learning. A thorough data analysis will be done during the summer after completing three remaining sections. Demographic and attitude data have been collected from the students in these courses that will permit correlation testing of multiple variables. During the fall semester of 2000, another instructor will be brought into the mix as well as two additional courses.

Some questions we hope to address in additional research relate to diffusion—"Is this approach applicable to all types of courses, and if not, where will it work?" and "Will it work for all types of instructors and students?" Other questions relate to implementation requirements—"Is it possible without the laptops and other technology aids?" and "How essential is the redesigned classroom facility?" Finally, there are issues of the future—"Where do we see this road taking us?" and "What are the future ramifications of this teaching model?"

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[1] Kolb, D.A. (1981) Learning styles and disciplinary differences. In *The Modern American College*.

Edited by A.W. Chickering and Associates. San Francisco: Jossey-Bass, 232-255.

[2] Keirsey,David M. (1998) Keirsey Temperament and Character Web Site [Online] <http://www.keirsey.com/cgi-bin/keirsey/newkts.cgi>

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Appendix A
Teaching and Learning Philosophies

My basic role as a professor is to teach in a way that my students are able to learn. Sounds reasonable, but there are some unknowns here. For example, what is it I'm teaching, what are students learning, and what are the students' roles?

Information systems is one of the fastest changing disciplines and trying to stay abreast of new technologies is a strain for both students and faculty. While those technologies have to be covered in the curriculum, my belief is to *emphasize the learning process for new technologies rather than the skill of the new technology*. Once in a professional position, an employee is valuable if they are able to locate resources for new trends, analyze them for relevancy and permanence, train themselves in the new skill, and know how to appropriately apply that new skill. In my classes, it's less important to memorize that a particular menu option is on the fourth menu, three down, in the submenu than it is to realize that scanning the menu looking for possible options or using the Search feature under Help will quickly produce the needed path. The next version of the software may rearrange the menu, but no one can take away a skill to scan or search.

In general I plan a mixture of *30% lecture (on just the hardest course content), 60% interactive class exercises, and 10% class open Q & A*. However, since different people learn better in different way, I use personality and learning type assessment tools and student conversations to help me fine-tune my teaching methods for a specific class. For example, if a class is quiet with few questions then I increase class exercises and if there are lots of questions it may indicate a need for a few more structured lectures. At the college level, students generally can self-learn much of the book material outside of class, but need more help in applying the material to situations. Assignments will often begin as a class exercise, assuming the book material has been covered outside, after students have a chance to clarify concepts with a Q & A. *In short, class time focuses on asking and doing.*

For years, I have believed that *effective teamwork is a critical skill to obtain.* For the same number of years, students have resisted teamwork for reasons you can all list. To overcome some of those criticisms, more classtime is available for group projects and training for teamwork is given early in the course. The JH226 classroom is equipped with group worktables with laptop computers that will be used during in-class projects. A lecture might be paused and each group asked to give something a try or to find out an answer.

While my classes aren't run as democracies, the student role is hardly a passive one. Schedules are planned with flexibility, assignments sometimes get modified as they do in a job setting, and students have to be prepared for the in-class project atmosphere. Constructively stating frustrations and needs should be possible on both sides of the table.

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Appendix B
Exercise on the Interactive Classroom Style

Opening day exercise in which students seated independently are asked to write out answers to questions

2 – 4

1. How many have taken classes using an interactive classroom approach?

2. Write down a definition of the term "interactive classroom". Compare that with 2-3 other people and agree on a common definition.

[possible answers]

- Less lecture
- More outside prep
- More like a lab/business
- Student-student class activities
- Interactive with instructor

3. What mental model will you as a student need to best fit this approach? Create a list of the model's features.

[possible answers]

- Listening skills
- Communication skills
- Knowing what you understand and don't and how to solve that
- Compromising skills Willingness to learn

4. Think about your initial reaction to this style... positive (intriguing, challenging, interesting), negative (fear, distrust, undesirable) and think about why. Debate this with 2-3 other people.

[possible answers]

- Scary
- Selective passiveness
- Lots of work
- Fear of lack of knowledge
- Nervousness
- Problems with group members

5. How many of you know the names of the people you have just interacted with?

[generally there is a mixed group of those who have asked names and those who were on the task alone]

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Abstract

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